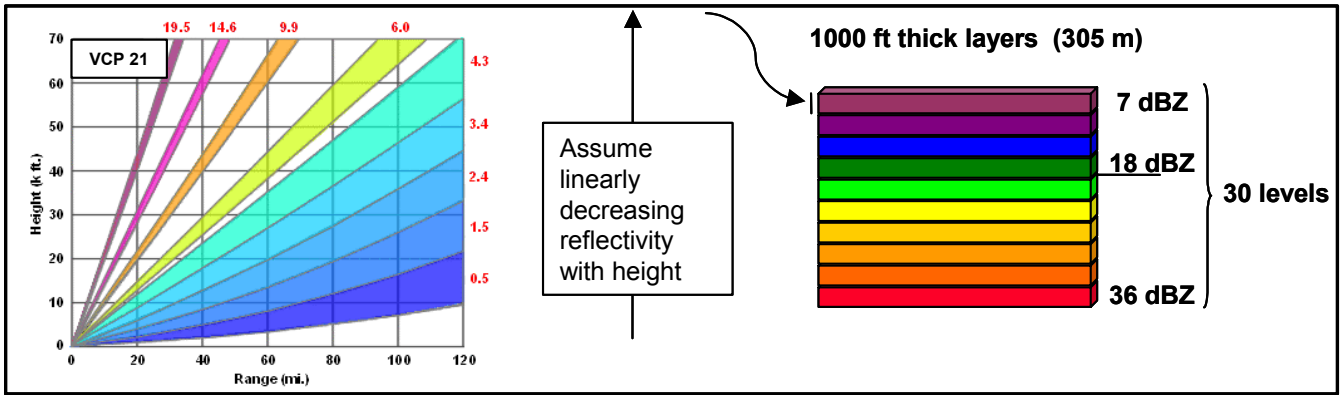
CIWS ENHANCED ECHO TOPS PRODUCT

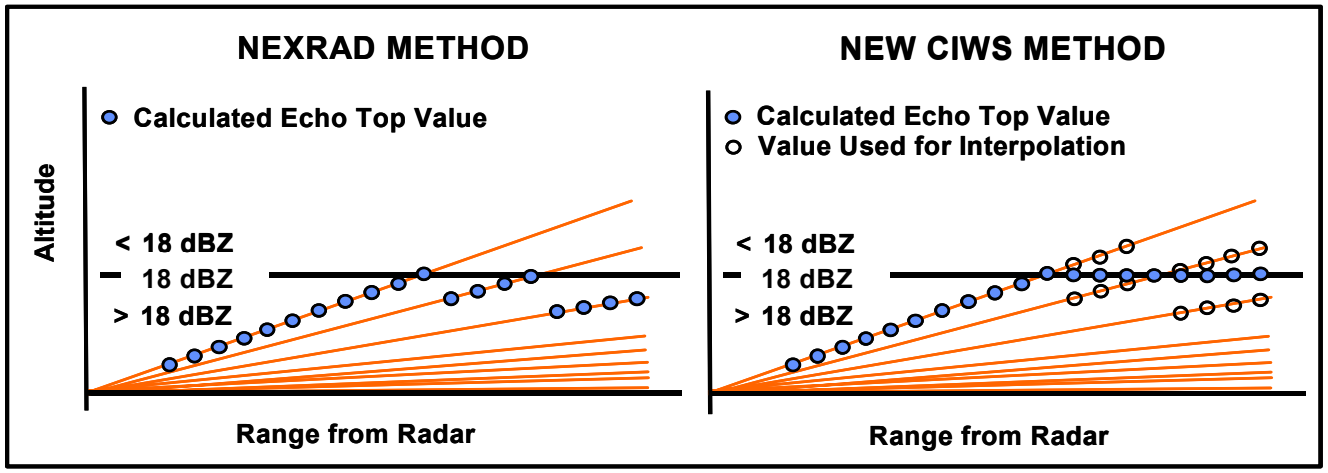
THE NEED FOR A NEW ECHO TOPS PRODUCT

Accurate echo tops levels and time trends are significant for the management of traffic in highly congested airspace. Studies* have shown pilots will fly over storms with echo top heights below the plane's altitude, suggesting that precipitation intensity alone is not sufficient for evaluating whether a jetroute can be used. The existing NEXRAD echo tops product has a coarse spatial resolution (4 km) and generally underestimates echo top heights due to its approximate method of computing the echo tops. As a consequence, operational users are reluctant to use the current echo tops product to identify opportunities for aircraft to fly over storms. To meet the needs of the CIWS users, an improved echo tops product has been developed that has a higher spatial resolution (1 km) and utilizes a vertical interpolation technique between the beams to more accurately estimate echo top values. Echo top heights from each NEXRAD in the CIWS domain are mosaiced together to create a final product with a spatial resolution of 2 km.

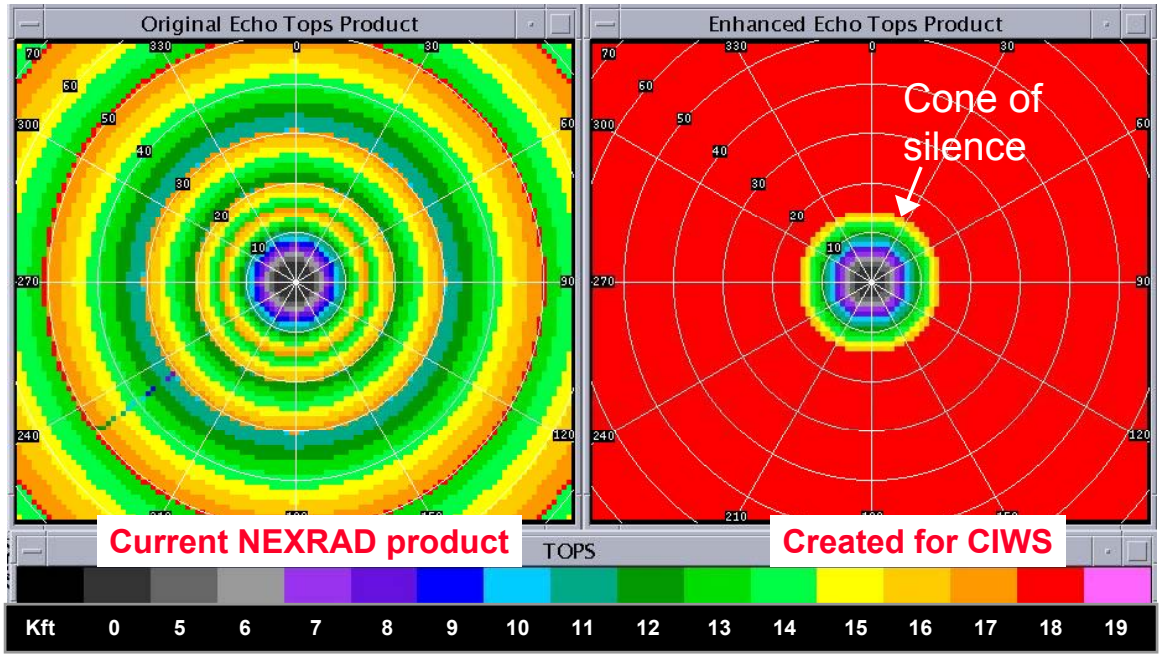
*Rhoda, D., E. Kocab, and M. Pawlak, "Aircraft Encounters with Thunderstorms in Enroute vs. Terminal Airspace Above Memphis, Tennessee", Tenth Conference on Aviation, Range, and Aerospace Meteorology, American Meteorological Society, Portland, OR, 13-16 May, 2002, 162-165.



An idealized storm model illustrates the benefits of the new echo tops estimation technique. Cartesian data with a 1 km horizontal resolution and 1000 ft vertical layers that decrease linearly in reflectivity value with height (right) is sampled with the NEXRAD VCP 21 scan strategy (left) to create polar data. The echo top is defined as the 18 dBZ level.



The vertical cross section depiction above illustrates how echo tops values are computed using the existing NEXRAD echo tops algorithm (left) and the new CIWS echo tops algorithm (right). The NEXRAD algorithm computes the height of the uppermost beam that equals or exceeds the chosen reflectivity level resulting in a saw tooth pattern of underestimation. The CIWS algorithm employs a vertical interpolation technique that uses data from two radar tilts to make an echo top estimate.

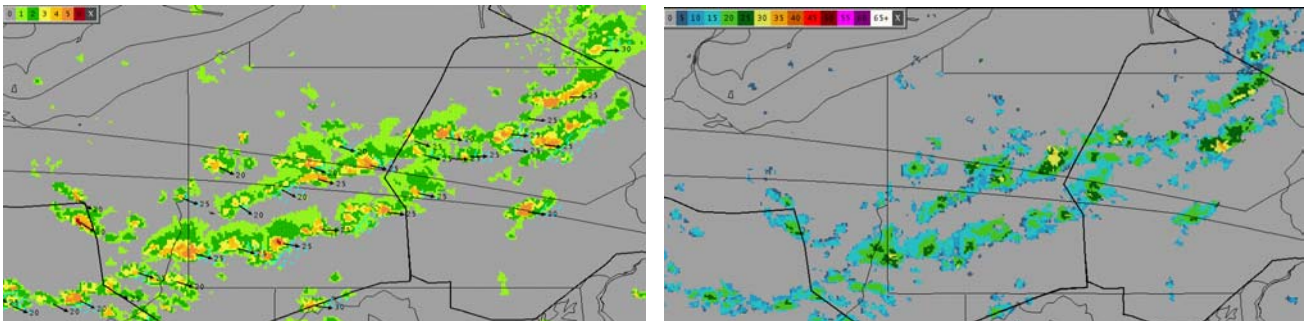


Polar reflectivity data from the idealized storm model described above were used to generate echo tops with the existing NEXRAD echo tops algorithm (left) and the new CIWS echo tops algorithm (right). Both algorithms produce the same echo top estimate near the radar where the product is indeterminate or "topped". The height of the idealized 18 dBZ layer is at 18 kft (red), which is correctly estimated by the new CIWS echo tops algorithm, but consistently underestimated by the existing NEXRAD algorithm.

CIWS User Comments

The new CIWS echo tops product became operational in the late summer of 2002 and has been widely accepted by the CIWS users. Below are typical FAA user comments recorded in the CIWS daily operations reports after the new product became available:

8/15/02 "He indicated that at roughly 2330Z, they were able to open J80 at FL 330+ based on CIWS. He added that he would not have done this without the good echo tops information provided by CIWS."
9/22/02 "Used CIWS echo tops exclusively to try to find spots in the line where overflights were possible."
9/28/02 "Used CIWS echo tops continuously to monitor the evolution of the storm tops."



CIWS NEXRAD precipitation (left) and echo tops products (right) for the severe weather event of 24 August 2002. The echo tops product shows that high level precipitation returns are associated with relatively low echo tops. The CIWS echo tops information permitted many aircraft to safely fly over the storms in Pennsylvania, thus significantly reducing aviation delays.

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